Crown

INTERNATIONAL

PROFESSIONAL HALLMARK OF QUALITY INSTRUMENTS

D-40

DUAL-CHANNEL

POWER AMPLIFIER

MODEL IM-4

Crown

INSTRUCTION MANUAL

Serial No. . . .
Issued . . . . . .

D-40

DUAL-CHANNEL

POWER AMPLIFIER

Div. of INTERNATIONAL RADIO & ELECTRONICS CORP. BOX 1000 ELKHART, INDIANA 46514

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DESCRIPTION

1.1 GENERAL

FIG. 1 - 1
D-40 MONITOR AMPLIFIER
(with recorder)

The D-40 is a dual channel, low distortion power amplifier for amplification of frequencies from 5Hz to 50kHz with operation into loads of 4 ohms and higher.

Well designed all silicon solid-state circuitry results in extremely low static heat dissipation and high stability. The circuitry is directly coupled with no transformers or capacitors.

The unit is extremely compact and portable, allowing mounting in carrying cases, speaker enclosures, and crowded relay racks. Mounting centers are standard for 19 in. relay rack mounting.

Total protection is provided by a fused, limited-energy power supply. Mismatched, shorted, or open outputs or RF inputs cannot harm the amplifier. The fuses (including an AC line fuse) are mounted behind a rear access panel.

The input voltage amplifiers are powered by two independent voltage-regulated supplies per channel (making an actual total of four regulated supplies). This results in complete channel-to-channel isolation and independence from line voltage variations.

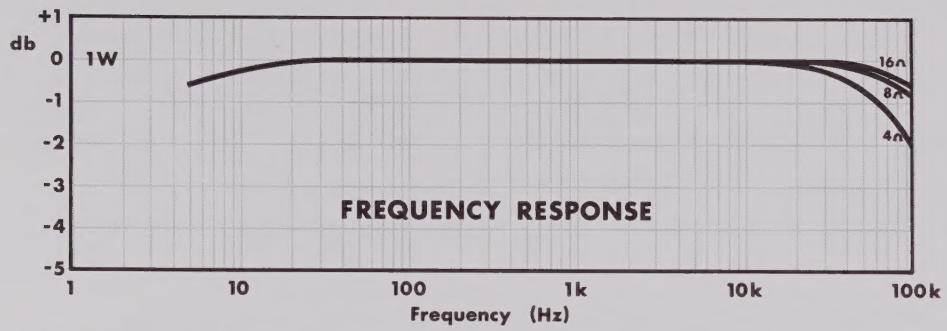
Turn-on is instantaneous with no loud thumps or program delays.

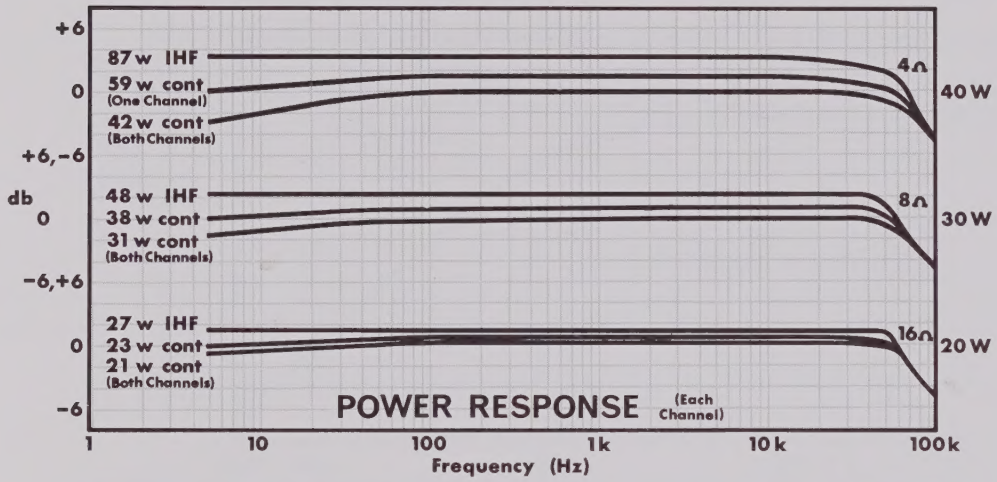
Mounted on the front panel are two independent level controls, a power switch with associated pilot light and an earphone jack.

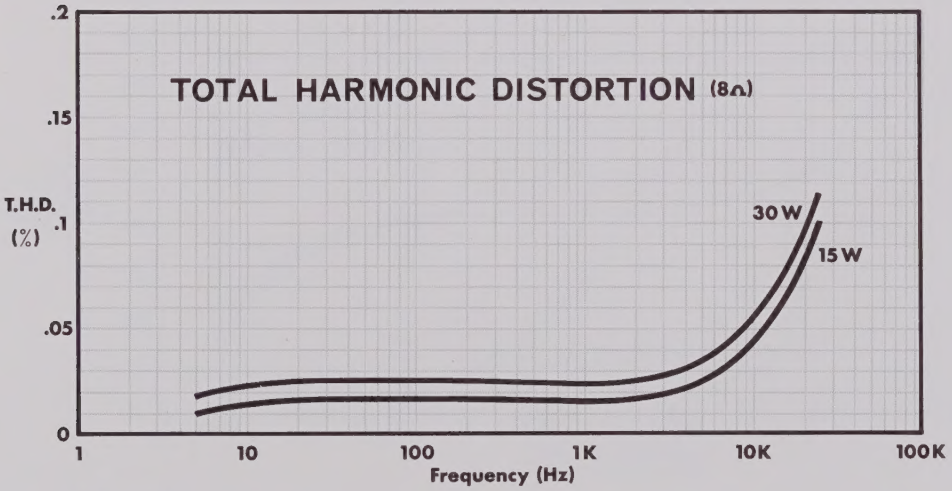
1.2 SPECIFICATIONS

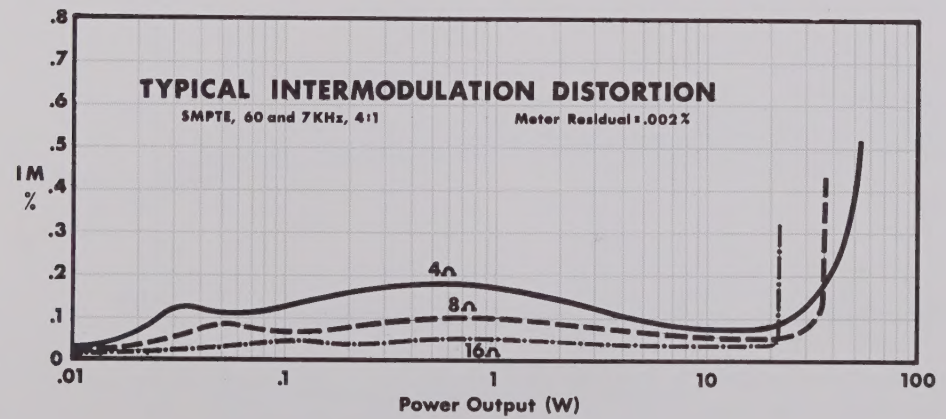
Frequency Response	±.1db 20Hz to 20kHz at any level up to 30 W. into 8 ohms. ±.5db 5Hz to 100kHz at 1 W. into 8 ohms.
Rise Time	1.5 micro-seconds at 1 W. into 8 ohms.
Power Response	±1db 5Hz to 50KHz into 8 ohms at 30 W.
Total Output (IHF)	Typically, 96 W. into 8 ohms. and 170 W. into 4 ohms.
I.M. Distortion (60Hz-7KHz, 4:1)	Less than 0.3% from 0.01 W. to 30 W. into 8 ohms. (See graph)
Damping Factor	Greater than 200 at frequencies below 1kHz into 8 ohms. (See graph)
Hum and Noise (20-20kHz)	100db below 30 Watts output (unweighted; 108db or ½ billionth Watt).
Slewing Rate	Typically 5 volts per micro-second. The "slewing rate" is the maximum value that the first derivative of the output may take on.
Load Impedance	4 ohms or greater. Stable with all speaker loads. Stable with all caps. less than 1 mfd and all cap. if isolated by 1 ohm.
Input Sensitivity	Approximately 0.7 V. for 30 W. into 8 ohms.
Voltage Gain	27db at 1kHz with level control fully CW.
Output Source Impedance	0.02 ohms nominal. (Input impedance is not affected by the level control . . . See graphs). 7.5 ohms thru headphone jack.
Turn-On	Instantaneous, with no large thumps or program delays.
Protection	Short, mis-match, and open-circuit proof, the D-40 is also invulnerable to Radio Frequencies. Protection is provided by a fusing system in all main DC supplies, coupled to a limited-energy power supply. The supply is further protected by an AC line fuse. Input overload protection is furnished by internal resistance at inputs on the amplifiers.
Power Supply	There are actually four power supplies (two per channel) providing complete isolation and stability. The D-40 also features a special compact low-external-field power transformer.
Power Requirements	Operates from 50-60-400Hz AC with double primary for 120 volt or 240 volt AC ±15%. Draws 10 watts or less in idle, 120 watts at 60 watts output into 8 ohm loads.
Heat Sinking	The entire aluminum chassis is used as a heat sink. The result is more-than-adequate heat sinking with a minimum of bulk.
Chassis	All aluminum for maximum heat conduction with a minimum of weight.
Controls	Independent level controls, power switch, and neon pilot light on front panel.
Connectors	Inputs: one ¼ in. phone jack and RCA pin jack per channel. Outputs: two ¼ in. phone jacks per channel and stereo headphone jack on front panel. Line: three-wire grounded AC.
Weight	8¼ pounds net weight.
Color	Black anodized chassis with bright anodized 1/8 in. aluminum front panel.
Dimensions	19 in. std. rack width, 1¾ in. high, 7-5/8 in. deep (from mounting surface).
Semiconductor Complement (all silicon)	18 transistors, 14 diodes, and 4 zener diodes.

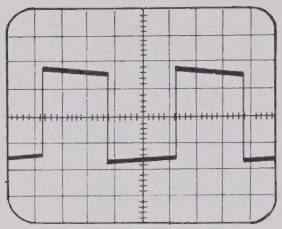
D-40 TYPICAL PERFORMANCE GRAPHS





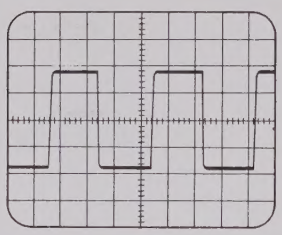




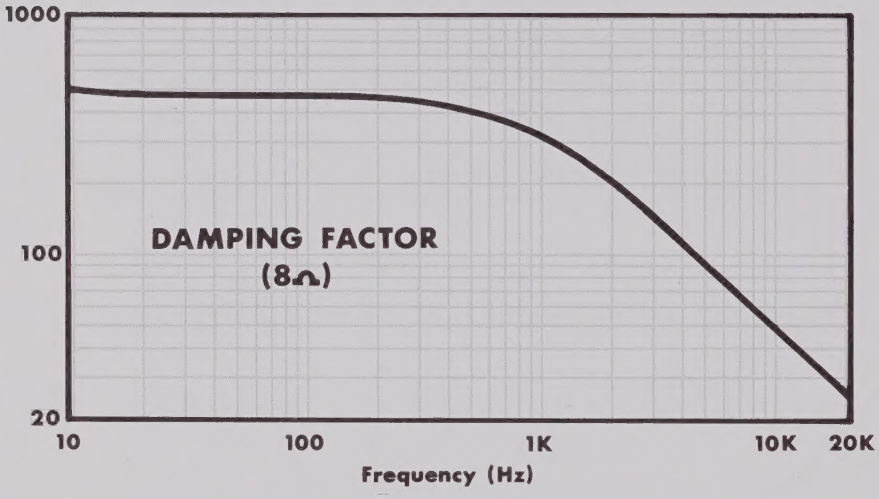


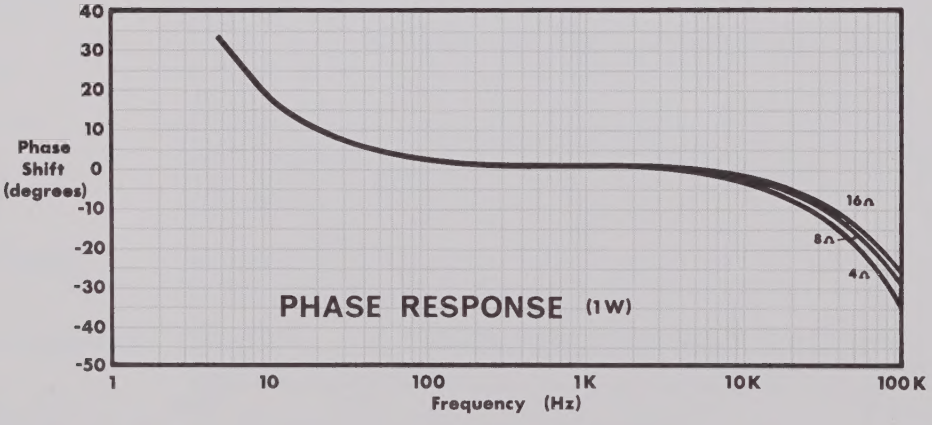
50 Hz

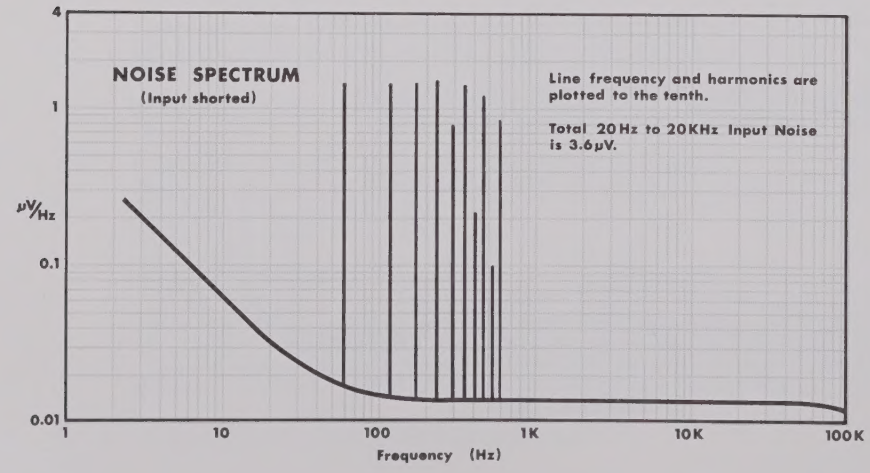
Square Wave Response (1 watt)

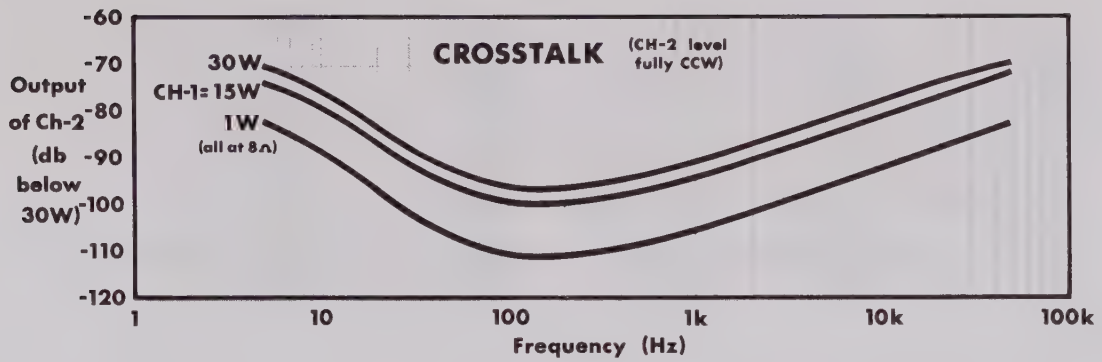


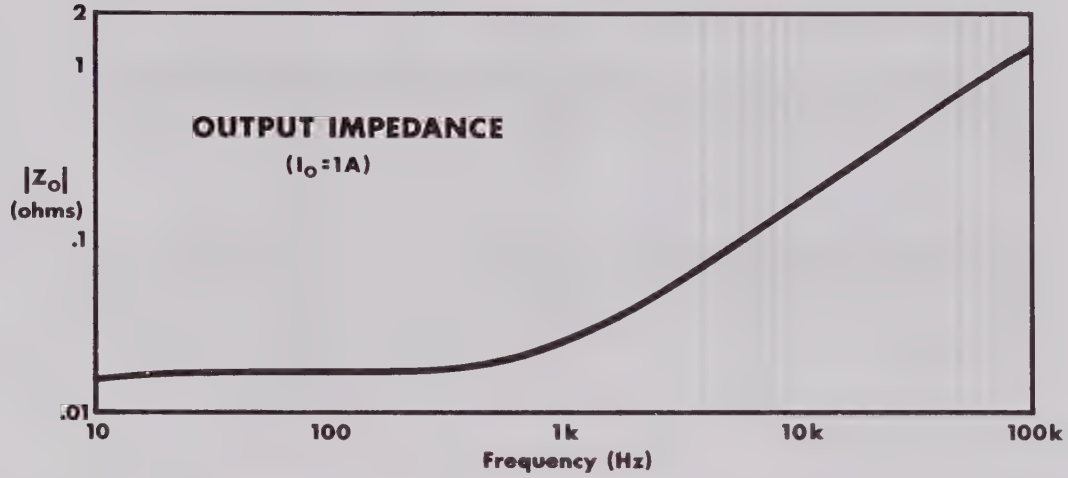
10 KHz

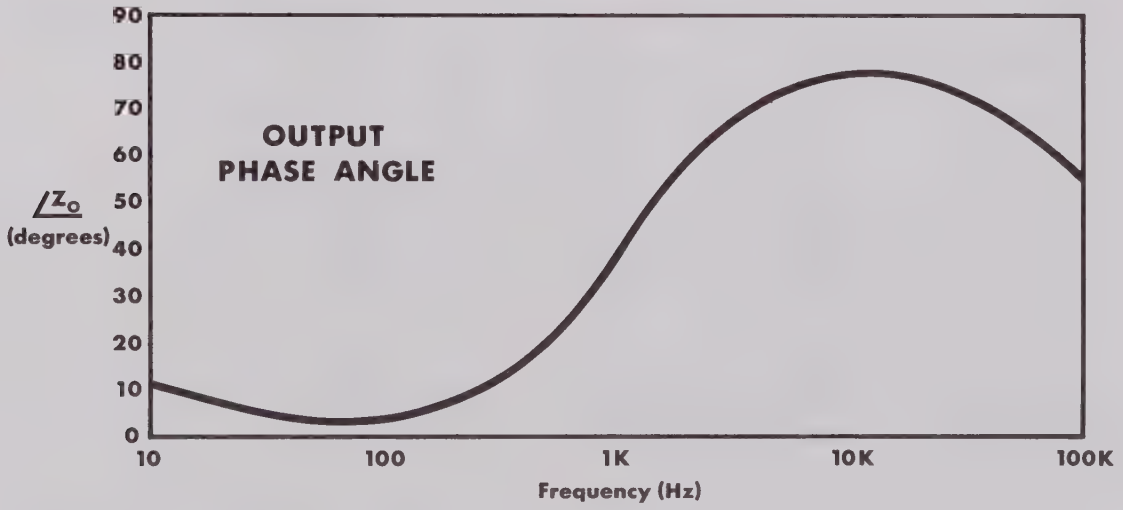


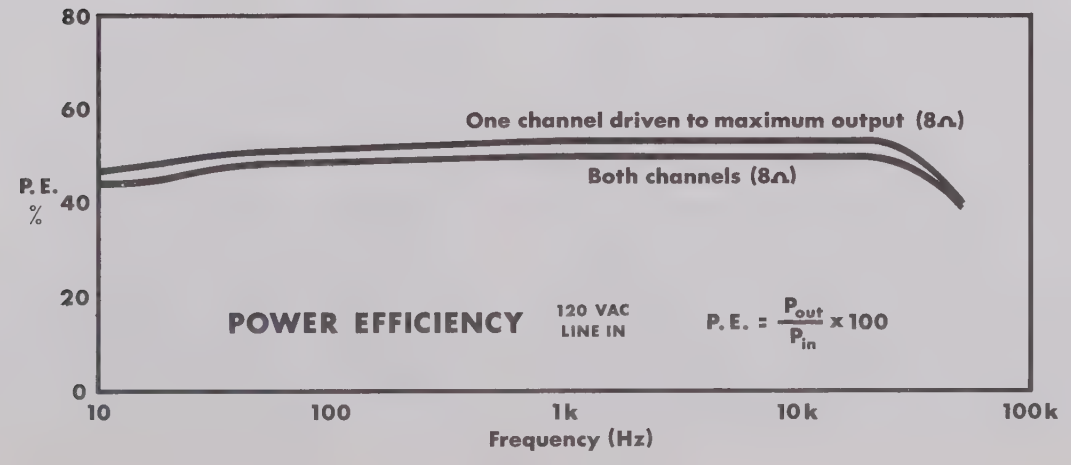





CROSSTALK
(CH-2 level fully CCW)
30W
CH-1= 15W
1W
(all at 8Ω)
Output of Ch-2 (db below 30W)
-60
-70
-80
-90
-100
-110
-120
1
10
100
1k
10k
100k
Frequency (Hz)


OUTPUT IMPEDANCE
(I_O=1A)
$|Z_O|$ (ohms)
2
1
.1
.01
10
100
1k
10k
100k
Frequency (Hz)


OUTPUT PHASE ANGLE
$\angle Z_O$ (degrees)
90
80
70
60
50
40
30
20
10
0
10
100
1K
10K
100K
Frequency (Hz)


One channel driven to maximum output (8Ω)
Both channels (8Ω)
P. E. %
80
60
40
20
0
POWER EFFICIENCY
120 VAC LINE IN
P. E. = $\frac{P_{out}}{P_{in}}$ x 100
10
100
1k
10k
100k
Frequency (Hz)

1.3 WARRANTY

CROWN guarantees this equipment to perform as specified. CROWN also warrants the components and workmanship of this equipment to be free from defects for a period of 90 days from date of purchase.

This warranty does not extend to fuses, and/or component or equipment damage due to negligence, misuse, shipping damage or accident; or if the serial number has been defaced, altered or removed.

An application for a FREE 3 year WARRANTY TITLE is included with this manual. Upon receipt of this completed form, CROWN will issue the Warranty Title—subject to the conditions contained therein. This title applies to the original end-purchaser and will be issued only upon the receipt of the application.

We urge that you take full advantage of this coverage—fill in and mail the application now!

1.4 ACCESSORY EQUIPMENT

1.4.1 P-A Adaptor Panel

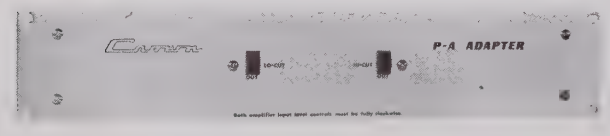


FIG. 1 - 2

FIG. 1 - 3

The P-A adaptor panel connects the inputs of the D-40 amplifier in a "push-pull" mode to obtain a monaural output. This results in 80 Watts of 25 volt balanced output from the two output terminals when terminated in 8 ohms, or 60 W (31v) when terminated in 16 ohms.

The P-A adaptor comes wired for an amplifier input impedance of 10K. Therefore it will be necessary to parallel the 18K resistors (furnished with the adaptors) across the amplifier inputs as described on a note with the resistors.

The adaptor panel provides 150, 600 and 5K ohm input impedances—all of which are isolated from ground. A .25v. or -10dbm (600 ohm) line will drive the amplifier to full output. Use a Pomona No. 1285 adaptor or solder inner conductor of std. ¼ in. phone plug to each "hot" output cable.

Two switches are provided on the front panel for insertion of Hi-Cut and Lo-Cut filters. The characteristics of these filters may be altered by changing internal capacitors in accordance with figure 1-4. The schematic is shown in figure 1-5.

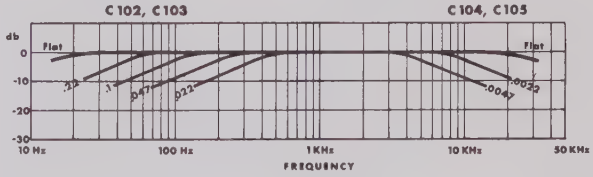


FIG. 1 - 4
P-A ADAPTER FILTER RESPONSE

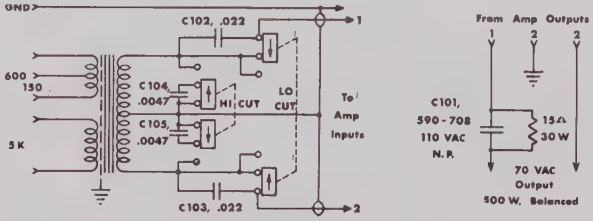


FIG. 1 - 5
SCHEMATIC of P-A ADAPTER

The output circuit contains a roll-off capacitor (C101) which should be used on the 25 volt line. This will prevent large low-frequency currents from flowing into the line-transformer primary(s).

If the transformer winding, or the impedance (DC resistance) of the speaker system is 6 ohms or greater, the system may be directly coupled to the amp output terminals – bypassing C101. Otherwise couple to the output terminals on back of the adaptor panel.

When using the P-A adaptor the input level controls on the amplifier should be set to maximum to insure gain balance between the two channels. This insures that one channel will not prematurely clip and restrict the maximum output power.

INSTALLATION

2.1 AFTER UNPACKING

Please inspect the amplifier for any damage incurred in transit. Since the unit was carefully inspected and tested at the factory, it left the factory unmarred. If damage is found, notify the transportation company immediately. Only the consignee may institute a claim with the carrier for damage during shipment. However, CROWN will cooperate fully in such an event. Be sure to save the carton as evidence of damage for the shippers inspection.

Even if the unit arrived in perfect condition, as most do, it is advantageous to save the packing materials. They will prove valuable in preventing damage should there ever be an occasion to transport or ship the unit.

Be sure to return the warranty registration form to the factory for full warranty-service coverage.

2.2 MOUNTING

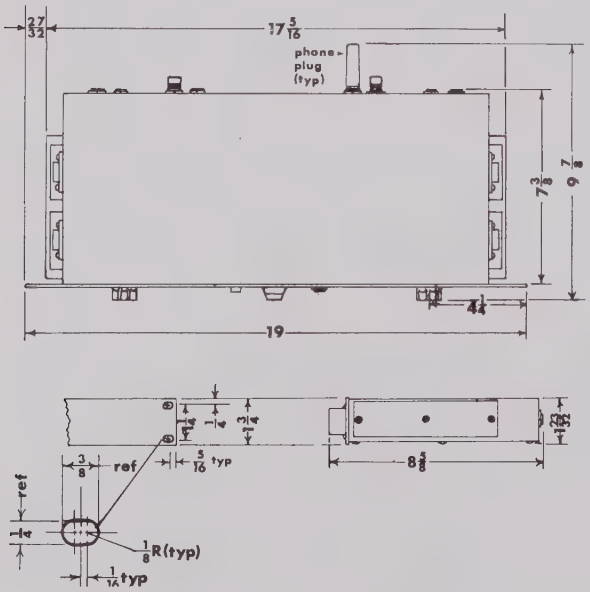


FIG. 2 - 1
D-40 MOUNTING DIMENSIONS

The D-40 is designed on a standard 19 in. rack-mounting format. Custom mounting is easily accomplished because of the small size and weight of the unit.

In any circumstance, sufficient ventilation should be provided for the amplifier. Applications in which the signal is of low duty cycle, such as music and speech, require little ventilation; while continuous signals (sinusoids, etc.) need more ventilation. Seldom is it necessary to use a fan unless the unit is conducting heavy work loads in an unusually hot environment.

2.3 CONNECTING SIGNAL LINES

Input and output connectors are located on the back of the chassis as shown in figure 2-2. The front panel has a special stereo-headphone output. This jack is wired for dual-channel operation in accordance with E.I.A. RS-331 Standard (barrel, common and ground; ring, left phone; and tip, right phone).

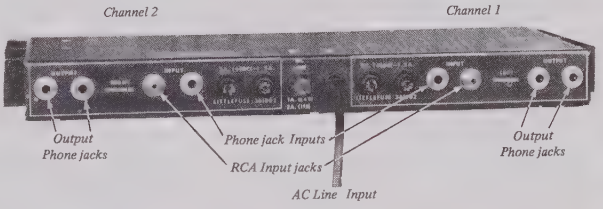


FIG. 2 - 2
BACK VIEW OF CHASSIS

It is always wise to remove power from the unit and turn the input level controls off while making connections (especially if the load is a loudspeaker system, as this will eliminate any chance of loud blasts). *Crown is not liable for any damage incurred to any transducer due to it being overpowered.*

The output connections (two per channel) are located on the extreme left and right of the back of the chassis. They are of the ¼ in. phone-type jack, so as to allow for quick connecting and disconnecting. Care should be used with the plugs to see that they are not internally shorted with frayed wires. A shorted load will cause the DC supply fuses (Little-fuse 361002) to blow.

Note that each channel contains two jacks wired in parallel. Therefore the minimum load impedance of 4 ohms (for example, two 8 ohm loudspeakers) must be observed collectively. Usually, any headphones connected to the front-panel jack will not affect this rear-panel minimum load.

Because the output wire gauge and length reduces the Damping Factor by adding series resistance, the following nomograph is provided for wire selection (figure 2-3). For dynamic moving-coil loudspeakers, the value of R1 should preferrably be that measured by an ohmeter across the voice coil, rather than the manufacturers rating. For electrostatic speakers and such, the manufacturer's rated impedance should be used for R1.

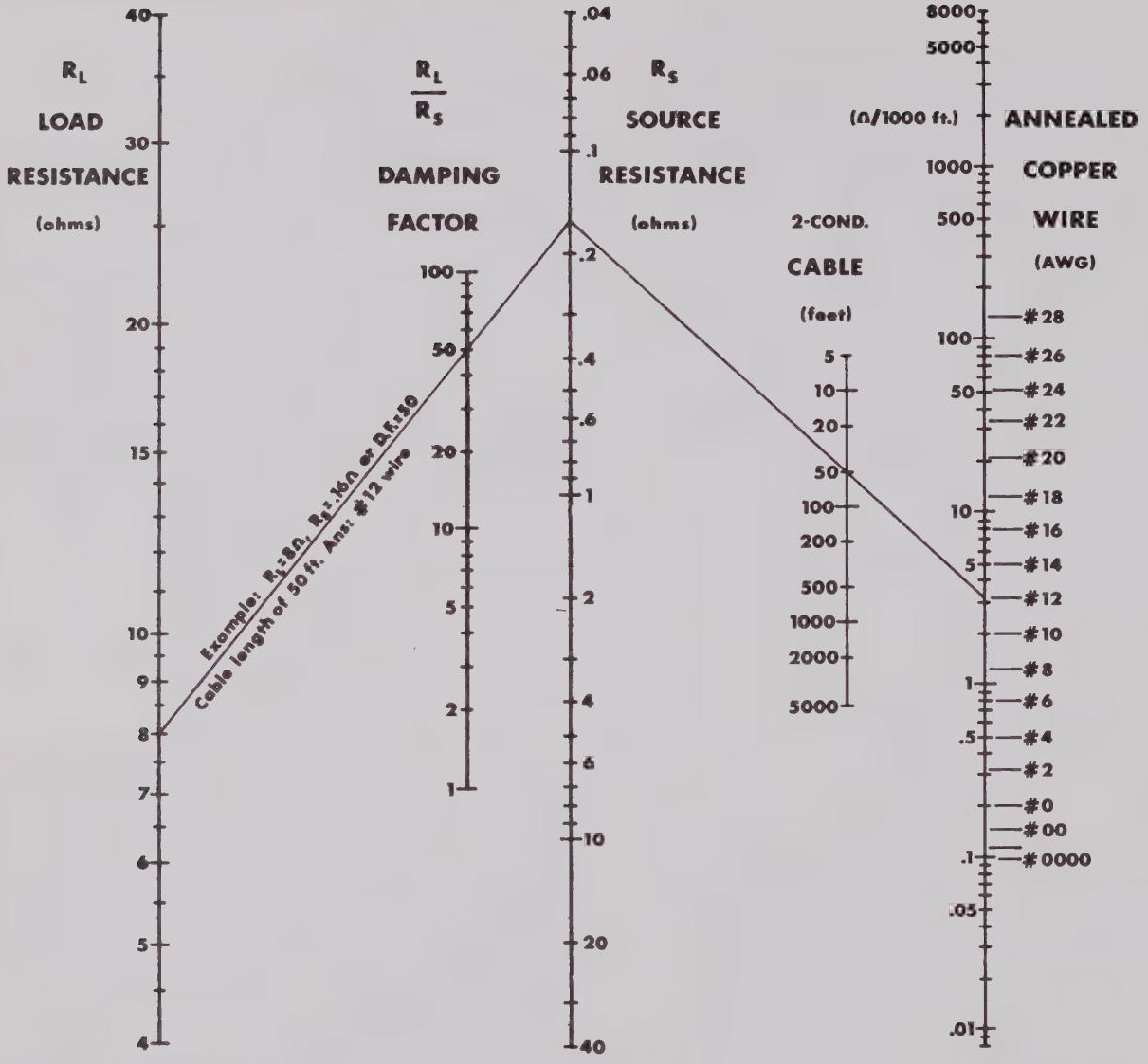


FIG. 2 - 3
SOURCE RESISTANCE and DAMPING FACTOR VS. LENGTH and SIZE of OUTPUT LEADS

If the load is a full-range (including woofer) electrostatic system or any other load which appears as a short at low frequencies, a large non-polarized capacitor and resistor should be placed in series with the transformer primary or load (which ever the case may be).

For electrostatic speakers, if the manufacturer has not provided such a capacitor, an external non-polar capacitor of 590-708 MFD and a 4 ohm power resistor should be placed in series with the "+" speaker load. This will prevent large low frequency currents from damaging the electrostat's transformer or from unnecessarily blowing the amplifier's DC supply fuses (Little-fuse 361002). An effective test to determine if such parts are needed is to measure the DC resistance between the output terminals with an ohmeter. If the resistance is less than 3 ohms the capacitor should be added as shown schematically in figure 2-4.

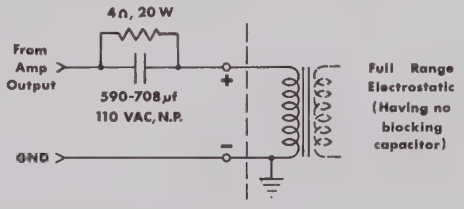


FIG. 2 - 4
SCHEMATIC FOR FULL-RANGE ELECTROSTATIC SPEAKER CONNECTION

When selecting connectors for the output lines, the same general precautions apply as do to all power connectors:

1. A male plug carrying signal must not be on the far end of the line where it can be exposed giving rise to

both a shock and short circuit hazard.
2. Connectors which might accidentally cause the two channels to be tied together during making and breaking of connectors should not be used. (A common example of such a connector is the standard 3-circuit ¼ in. phone jack and plug when wired for stereo sound.)
3. *Connectors which can be plugged into AC power receptables should never be used.*
4. Connectors having a low current-carrying capacity, or having high propensities to short or have shorted leads, are to be avoided.

2.4 CONNECTING INPUT LINES

The input connection(s) to the D-40 amplifier may be made with the RCA pin-type plug or the ¼ in. phone plug. Internally, these jacks are paralleled (on each channel). Occasionally two signals will be fed simultaneously to each channel—requiring an external mixing network (depending on source impedances and isolation). For example, two CROWN recorders may be connected since isolation is provided within the machines (both outputs on SX, RCA pin on CX).

In high-fidelity audio applications any good vacuum-tube or solid-state control center will operate successfully into the 25K ohm inputs of the D-40. Occasionally a high-impedance output of poorly-designed preamps will be encountered, and/or a larger output coupling capacitor may be required (to prevent excessive low-frequency rolloff).

For loudspeaker-driving applications, the input should be free of large sub-audio or undesired low frequencies, as they cause overheating and overloading of the loudspeaker. To remove such low frequencies, a series capacitor may be placed in the input signal line. (The graph of figure 2-5 indicates the effect of the size of the capacitor on the frequency response.) Only a low-leakage paper, mylar, or tantalum capacitor should be used for this purpose.

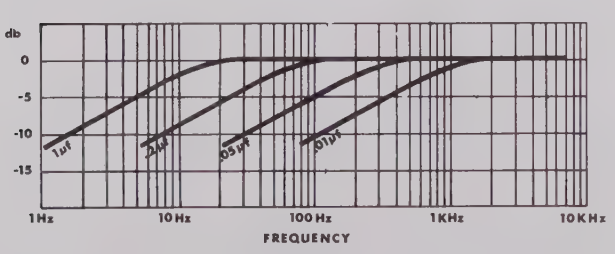


FIG. 2 - 5
GRAPH for SELECTION of INPUT CAPACITOR

If large amounts of ultrasonic or radio frequencies are found on the input (bias from tape recorders, hash from demodulators, etc.) a low-pass filter should be placed on the input. While practically-obtainable RF input levels will not damage the amplifier, they may cause burn-out of tweeters or other sensitive loads, or blow the amplifier's DC supply fuses. The following filters are recommended for such applications: (Figure 2-6).

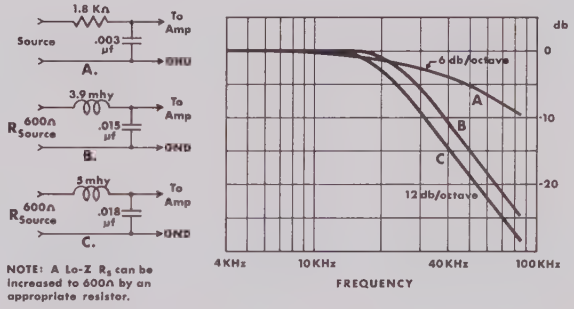


FIG. 2 - 6
LOW PASS INPUT FILTERS

The second problem arising with input hookups is ground loops. "Ground loop" is the electronic jargon for any ground wire that is wired in such a way that it causes undesirable circulating currents to flow in the ground wiring. (The most common form is that of a magnetic hum field being picked up by the area enclosed by a pair of output cables that have a common ground. The second most common is the case where the amplifier input and output grounds are externally tied together.)

Tying the input and output grounds together externally may also cause the third type of input connection problem—feedback oscillations due to returning the output to the amplifier's input. (if the load current is flowing in this loop) The output may become coupled back to the input via the power line, through AC line powered devices metering the output in industrial uses where the input is also derived from an AC-line-controlled device. Such installations should provide adequate isolation at the input and/or ground the amplifier to the power line ground.

2.5 CONNECTING POWER

The amplifier is furnished with a three-wire AC plug as standard equipment, and adaptors are readily available commercially for adapting this to a two-wire system if necessary.

The amplifier may be internally wired for either 120 or

240V AC unless 240VAC was specified upon ordering. Figure 2-7 shows pictorially how the 240 VAC-connected unit should appear. Note the change to a 1a. line fuse.

Only a competent technician or a CROWN dealer should attempt alteration of the line voltage hookup.

When testing the amplifier, the line voltage should be sinusoidal and of the same potential, ±1% of the specified 120 (or 240)VAC.

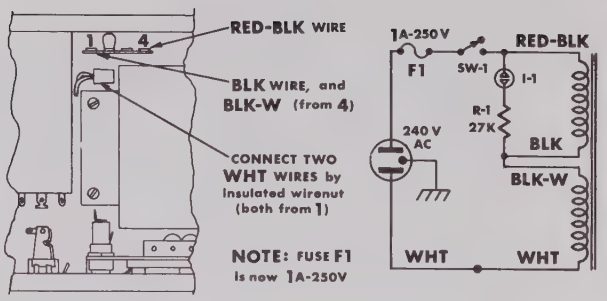


FIG. 2 - 7
LINE VOLTAGE CONNECTIONS (240 VAC)

OPERATING INSTRUCTIONS

3.1 OPERATING CONTROLS

The D-40 contains all the facilities essential for a high-performance amplifier. (See Fig. 3-1.)

FIGURE 3 - 1
OPERATING CONTROLS

On the front panel are located independent level controls, a power switch, a stereo headphone jack, and a pilot light.

Each level control should be adjusted for the desired amplifier gain or output level. When the controls are fully ccw, the gain is zero.

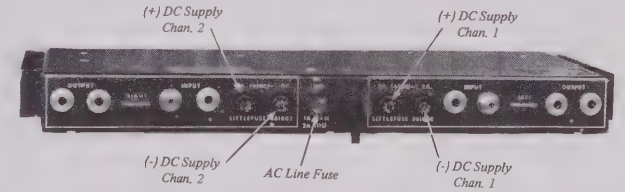
The pilot light will illuminate, and AC power will be applied, when the toggle switch is moved up. It may remain up if the AC power to the D-40 is switched by associated equipment (tape recorder, control center, etc.). As the D-40 dissipates about 10 watts at idle, many installations will benefit from continuous operation.

3.2 THE PROTECTION METHOD

The D-40 employs massively overated output transistors for the size of amplifier that it is. The use of rugged 150W transistors with a limited-energy power supply renders self-destruction an impossibility. The stored charge and regulation of the power supply is such that the output circuitry is capable of absorbing this energy for a period which is long enough to exceed the blowing time of the DC supply fuses (Littlefuse 361002). If larger or slower fuses are used, the energy delivered by the supply will be more than the output circuitry can absorb; therefore the warranty is valid only with the specified fuses. (The fuses are shown in figure 3-2.)

The amplifier's slewing rate is internally limited to conform with the safe switching-rate of the output transistors. This, coupled with the limited energy supply, renders destruction due to an RF input impossible. The input circuitry contains an R-C low-pass filter which begins its roll-off at 800kHz. The input is protected against overdrive-damage by a series-limiting resistor, should the input level ever become very excessive.

The amplifier's voltage-amplifier circuitry is designed to be inherently current limited; thereby, if any of the devices should fail (which is extremely unlikely) no damage will occur to the rest of the stages.



Note: All DC Supply fuses are Littlefuse No. 361002 (8AG, 2a.) or Buss AGX-2. The AC line fuse is a 2a-250V, 3AG for 120 volt line (1a. on 240VAC line).

FIG. 3 - 2 FUSES

3.3 OPERATING PRECAUTIONS

A number of operating precautions are herein given as an aid to understanding of proper and improper amplifier usage:

Never parallel the two outputs by directly tying them together or parallel them with any other amp's output, as this does *not* result in increased power output. Damage incurred by such operation is not covered under warranty.

Never drive a transformer-coupled device or any other device which appears as a low-frequency short (less than 3 ohms) without a series-isolating capacitor. Such operation may damage the device and/or blow the amplifier's DC supply fuses.

Do not short the ground lead of an output cable to the input-signal ground, as oscillations may result from forming such a ground loop.

Never remove fuses with power applied. Resulting output signals could damage the load.

Never connect the output to a power supply output, battery, or power main. Damage incurred is not covered under warranty.

Fuse the amplifier only as indicated.

Do not expose the amplifier to corrosive chemicals such as softdrinks, lye, salt water, etc.

Operate the amplifier from AC mains of not more than 15% above the selected line voltage and only on 50, 60 or 400Hz AC. (Failing to comply with these limits will also invalidate the warranty.)

The amplifier is not recommended for full power industrial usage at frequencies above 50kHz.

Tampering in the circuit by unqualified personnel or the making of unauthorized circuit modifications invalidates the warranty.

Use care in making connections, selecting signal sources, and controlling the output level. "The loudspeaker you save may be yours." CROWN is not liable for any damage done to loads due to careless amplifier usage or for those damaged by being deliberately over-powered. (For pointers on load protection see section 3.4.)

Do not expose the output leads to areas likely to be struck by lightning. Such an installation could destroy the amplifier.

3.4 LOAD PROTECTION SCHEMES

The most common of all protection schemes is a fuse in series with the load. The fuse may be single, fusing the overall system; or (in the case of a multi-way speaker system) multiple with one fuse on each speaker. Fuses help to prevent damage due to prolonged overload but provide essentially no protection against damage that may be done by large transients and such. To minimize this problem, high-speed instrument fuses (such as Littlefuse 361000 series) are most appropriate for such applications. (For a nomograph showing the case of fuse size v.s. loudspeaker ratings, refer to figure 3-3.)

Another form of load protector is shown schematically in figure 3-4. Whenever the load is overdriven a relay switches a lamp in series with the load, smoothly relieving the overload. The lamp then doubles as an overdrive indicator as it glows. This system, by adjusting the relay tension adjustment and the protection level control is useful from 25 to 200 watts for a typical 8 ohm load.

Another (but more sophisticated) form of overload protector relieves the overload by controlling the amplifier's input signal which is creating the overload. This form of protector not only saves the load, but also eliminates amplifier overload. With this device, it is possible to operate the amplifier at its maximum level with a minimum of clipping. This device is shown schematically in figure 3-5, and features an overdrive indicator, distortionless photo-optical control, and a protection level control—giving adjustment for 1W to infinity when driving 8 ohms.

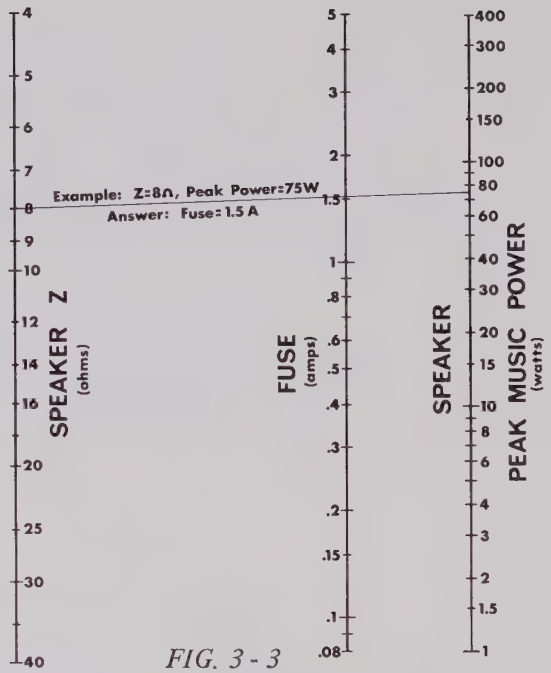


FIG. 3 - 3
FUSE SELECTOR NOMOGRAPH FOR LOUDSPEAKER PROTECTION

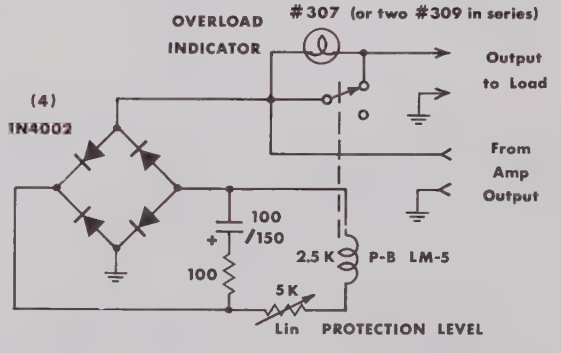


FIG. 3 - 4
RELAY-CONTROLLED PROTECTOR

A common problem which causes damage and irritation is the turn-on thump—typical to many signal sources such as Hi-Fi preamplifiers. Figure 3-6 shows the schematic of a muter which, when inserted in the input signal line, mutes for several seconds before connecting the source to the amplifier; thereby eliminating turn-off transients which occur after the relay drops open (less than 0.1 sec.).

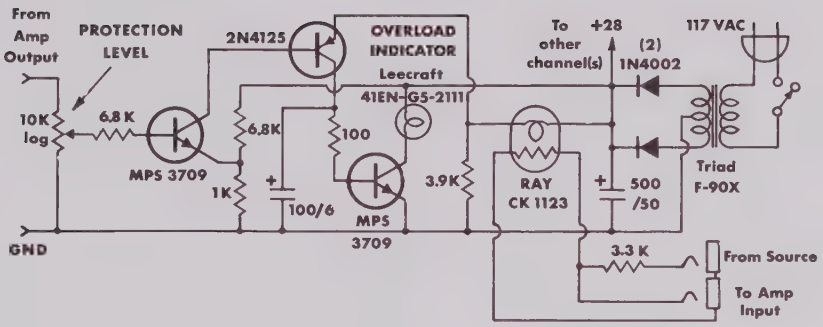


FIG. 3 - 5
PEAK-POWER LIMITING COMPRESSOR WITH OVERDRIVE INDICATION

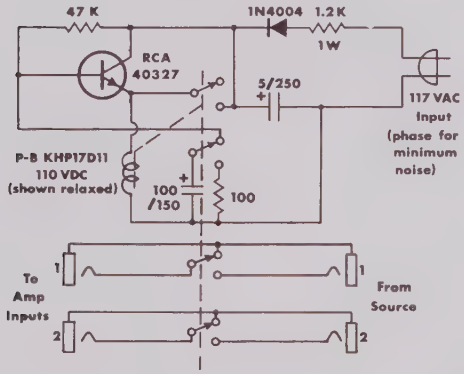


FIG. 3 - 6
TURN-ON-TRANSIENT MUTER FOR LOAD PROTECTION

3.5 CLEANING

The CROWN D-40 has a rugged, anodized front panel for lifetime service. The panel can be cleaned with a moist cloth and mild detergent.

Never use steel wool; scouring powder, lye solution or any strong abrasive cleaner, as these will damage the finish.

The back chassis should require no more cleaning than periodic dusting. To dust these areas, use a clean, dry cloth. The use of detergents, etc., will remove the fine film of oil from the black anodized chassis which is used to increase its surface lustre.

CIRCUITRY

4.1 PRINCIPLES OF OPERATION

The D-40 employs two direct-coupled amplifier circuits which use silicon semiconductors in all stages. Careful and conservative design results in reliability and quality of performance not obtainable previously at any price.

The output stage is directly coupled to the load; thereby eliminating the distortion and power-bandwidth-deterioration effects of transformer and capacitor coupling methods. The configuration used is of the quasi-complementary type—having 150W silicon output transistors (Q1, Q2) with 30w silicon complementary drivers (Q3, Q4). The output biasing method employs resistor-diode networks (CR 5, R3 and CR6, R7) to provide reliable, temperature-independent bias control without resorting to hazardous, unreliable manual adjustments or critical thermal-feedback-compensation schemes.

Q5 is the final voltage amplifier and is bootstrapped by C8 and R9 to provide adequate up-swing current drive to the output stage.

Q7 is employed as a grounded base isolation between the next to the last voltage amplifier (Q6) and Q5. Otherwise signals or hum on the unregulated negative DC supply would be induced into R16 by the output admittance of Q6.

C9 is used to limit the slewing rate of Q5 and control the high-frequency open-loop gain-behavior of the voltage amplifiers. C14, C10, R13, and R15 are also used to provide high-frequency compensation.

Q8 and Q9 form a low-noise differential-input amplifier which obtains its input from the low pass RC filter (R21 and C12) and obtains its feedback signal from R14 (with C10 and R15), fed to C11 and R19. C11 allows the output DC offset to be totally fed back to the input resulting in very low DC drift at the output. C11 also forms a bootstrap with R20 to increase the input impedance of the amplifier to a very large value (such that R22 forms the principle part of the input resistance.)

CR7 and CR8 regulate the voltages supplied to the input voltage-amplifiers. They provide complete channel-to-channel isolation and insensitivity to line voltage variations. They also provide limited-current supplies for the input amplifiers as an anti-destruction safeguard.

4.2 TEST PROCEDURES

The sole function of this section is to list precautions which are essential to obtaining accurate measurements when dealing with high quality amplifiers such as the D-40.

1. Use the proper line voltage. The line voltage is sinusoidal 120V (or 240V) AC at 60Hz, and should be measured and held to 1% accuracy throughout all testing. All measurements should be taken at the power amps plug.

2. The load should be resistive, having less than 10% reactive component at any frequency up to 5 times the highest test frequency. The resistor should be capable of continuously dissipating the full output of the amplifier while maintaining its resistance within 1% of the rated value. All connections made to the load must be tight; (not ohmic). All output measurements should be taken at the amplifier's terminals and not anywhere along the output cable through which the load current is flowing.

3. The input level control should be set to maximum for all distortion tests. This assures repeatability for all measurements.

4. When measuring hum and noise, all inputs should be disconnected from the amplifier and the level controls set to minimum, or to maximum if a shorting plug is placed on the inputs.

5. Whenever possible, avoid ground loops in the test equipment caused by connecting the output ground to the input ground. Never connect the input ground of the cable going from the load back to the input ground.

   Ground loops are especially troublesome when measuring distortion. A distortion analyzer (such as an IM meter) typically has the signal output and input terminals tied to a common ground. Such a test should use an ungrounded output return with output lead wrapped around the grounded and well-shielded input cable.

6. Always monitor the test oscillator when measuring frequency response. Use a wide band AC Volt-meter, or use the same meter for both input and output level measurements (if the meter's frequency response is known to not be dependent on attenuator settings).

7. Accuracy in measuring voltages for computing wattages cannot be overstressed. A 1% error in voltage corresponds to a 2% error in the wattage, etc.

8. Residual distortion and noise levels should be fully known for all the test equipment in order to accurately evaluate the amplifier.

9. Never attempt to measure damping factor by placing abnormal loads on the output. Damping factor measurements taken when clipping or any other form of overload is occurring are meaningless. The preferred method is to apply an externally generated current to the output terminals and measure the resultant voltage across the terminals. A convenient current is 1A; as this causes the resultant voltage to read directly in ohms for |Zo|. Damping factor is defined as $\frac{|Z_L|}{|Z_o|}$ where |ZL| usually 8 ohms. A convenient generator for the 1A current is the channel of the amplifier which is not under test. A resistor of say 8 ohms, coupled between the two channels' output terminals, will provide 1A when 8 volts are impressed across the resistor.
10. Never measure hum and noise when in the presence of strong AC magnetic fields. The amplifier should be at least 4 in. away from any large metallic or shield plates for a reading to be meaningful.

4.3 SERVICE

Should service other than routine fuse replacement ever be required, it is recommended that the unit be sent to the nearest CROWN service station or to the factory. For warranty service, the amplifier must be returned to the factory.

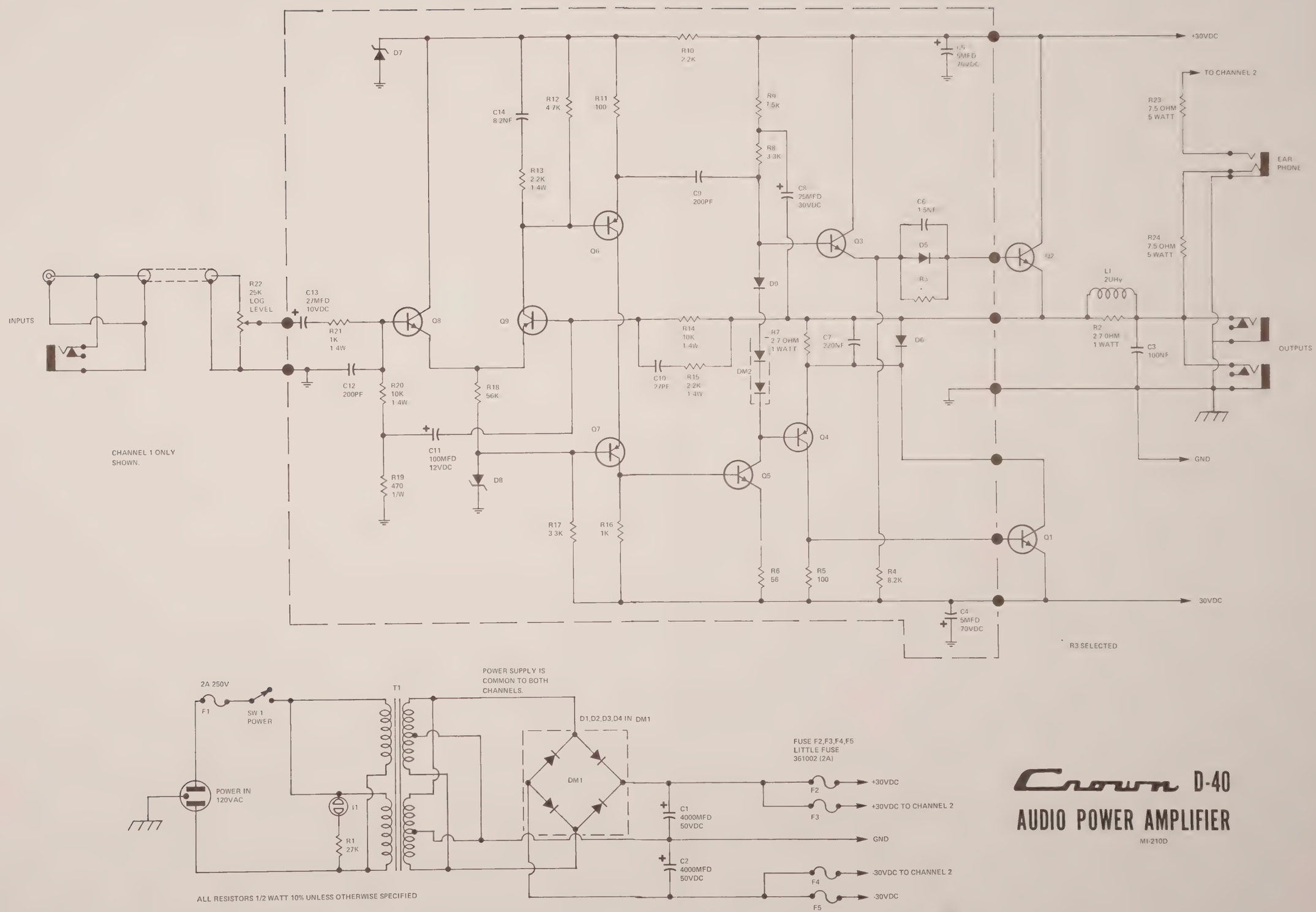
Because of the level of circuitry sophistication of the D-40, only the most competent of technicians should be allowed to service it.

Many of the parts are standard items stocked by most supply houses. However, there are several which may appear to be standard parts but are actually different. Although standard parts may be used in an emergency, best results will be with factory parts. Some of the parts are available only from CROWN.

When ordering parts, be sure to give the amplifier serial number as well as the part number and description. Rated firms will be billed; otherwise shipments will be C.O.D.

Before returning an amplifier to the factory for service, authorization should first be obtained from the service manager.

All shipments must be sent by Railway Express or truck freight, prepaid and insured at total value. The factory will return your serviced unit by Railway Express or truck freight, collect, and will ad C.O.D. charges in the event that the cost is not covered by registered warranty.



Crown D-40

AUDIO POWER AMPLIFIER

MI-210D

D-40 Parts List (SD Series)

Schematic Ref.	CROWN Part No.	Description	Notes
BULBS			
I1	2500	Ne2H Neon Lamp	
CAPACITORS			
C1, C2	1894	4000/50 Electrolytic	(Must be insulated)
C3	2938	.1/250 Mylar	
C4, C5	1678A	5/70 Electrolytic	
C6	1692	.0015 Capacitor	
C7	2625	.22 Ceramic	
C8	1087	25/30 Electrolytic	
C9, C12	1118B	200 PF Mylar	
C10	2342	27 PF Mylar	
C11	1635	100/12 Electrolytic	
C13	1914	27/10 Tantalum	
C14	3063	.0082 Capacitor	
CHOKES & TRANSFORMERS			
L1		Coil W/Slug	
T1	2097A	200P23B Transformer	
CONNECTORS			
J1	2925	3501FR Phono Jack	
J2, J3, J4	1527	Carter Jack	
J5	1530	Stereo Jack	
FUSES			
F1	2163	3Ag 2A Fuse	
F2, F3, F4, F5	2489	8Ag 2A Fuse	Little fuse No. 361002, or Buss AG X-2.
POTENTIOMETERS			
R22	2942	25K Audio-Taper Pot.	
RECTIFIERS & DIODES			
CR1, CR2, CR3, CR4	3062	VH148 Epoxy Bridge	Earlier units used (4) MR2070 diodes.
CR5, CR11	2798	MZ2360 Diode	
CR6	2941	1N5402 Diode	
CR7, CR8	3277	1N968B Diode	
CR9, CR10	3039	MZ2361 Diode	Earlier units used (2) MZ2360 diodes.
RESISTORS			
R1	1056	27 K, ½ W.	(Common to both channels.)
R2, R7	1001	2.7 Ohm, 1 W. Resistor	
R3	selected	½ W. Resistor	selected for total 65 milliamp bias current in each channel.
R4	1005	8.2 K, ½ W.	
R5, R11	1007	100 Ohm, ½ W.	
R6	1009	56 Ohm ½ W.	
R8, R17	1051	3.3 K, ½ W.	
R9	1076	1.5 K, ½ W.	
R10	1036	2.2 K, ½ W.	
R12	1640	4.7 K, ½ W.	

Schematic Ref.	CROWN Part No.	Description	Notes
R13, R15	2628	2.2 K, ¼ W.	
R14, R20	2631	10 K, ¼ W.	
R16	1053	1 K, ½ W.	
R18	1663	56 K, ½ W.	
R19	2626	470 Ohm, ¼ W.	
R21	2627	1 K, ¼ W.	
R23, R24	1697A	7.5 Ohm, 5 Watt Resistor	
SWITCH			
SW1	1892	SPDT McGill Switch	
TRANSISTORS			
Q1, Q2	2539	2N3714 Transistor Motorola	
Q3	2986	2N4923 NPN Trans.	
Q4	2985	2N4920 PNP Trans.	
Q5	2961	2N3859A Sprague	
Q6, Q7	2982	TZ581 Special	(60V BV ceo)
Q8, Q9	2962	TZ-81	(Matched Pair)
MECHANICAL ASSEMBLIES			
	SA30	Circuit-Board Ass'y	(Specify Serial Number of amplifier)
MECHANICAL PARTS			
	1221	HMB Fuse Holder	
	3256	HTA Fuse Holder	
	1281	6-32 x ¾ Blk, Nylon Screw	
	1296	No. 6 Fiber Washer	
	1306	Shoulder Washer	
	1646	5/8 x 3/8 Fiber Washer	
	2008	6-32 x 3/16 Bd. Hd. Phil, Screw	
	2046	Bright Nut	
	2189	Bright Washer	
	2252	6-32 x ¾ Flat Hd. Screw	
	2468	Amber Lens Cap & Clip	
	2648	Mica Insulator Washer	
	2803	SR-5P-1 Strain Relief	
	2824A	AC Cord (Male End only)	
	2852	No. 8 x 1 in. Sheet Metal Phil. Screw	
	2301	S-647-3L Knob	
	2948	3/8 Spacer	
	2649	Shoulder Washer	
	3067	6-32 Bellevile Washer	
	7862	Chassis	
	6993	Bottom Cover	
	6995	Transistor Cover	
	7155	Fuse Bracket	
	7741	SA30 Circuit Board	
	7771	Front Panel	

D40 Price List (SC Series)

CROWN#	Price ea.
Bulbs	
2500	.24
Capaciters	
1087	.98
1118B	.21
1635	.98
1678A	.37
1692	.33
1894	4.97
1914	1.72
2342	.21
2625	.33
2938	.33
3063	.15
Chokes & Transformers	
2097A	20.60
Connectors	
1527	.42
1530	.85
2925	.45
Fuses	
2163	.10
2489	.10
Potentiometers	
2942	.77
Rectifiers & Diodes	
2103	2.07
2798	.40
2941	1.00
3039	.95
3062	4.25

CROWN#	Price ea.
Resistors	
Selected	
1001	.20
1005	.12
1007	.12
1009	.12
1036	.12
1051	.12
1053	.12
1056	.12
1076	.12
1640	.12
1663	.12
1697A	.37
2626	.12
2627	.12
2628	.12
2631	.12
Switch	
1892	.81
Transistors	
2539	7.38
2961	.52
2962	.70
2982	1.00
2985	3.75
2986	3.00
Mechanical Assemblies	
SA30	45.00
Mechanical Parts	
1221	.64
1228	.30
1281	.10
1296	.05
1306	.05
1646	.05
2008	.05

CROWN#	Price ea.
Mechanical Parts	
2046	.05
2189	.05
2252	.05
2468	.20
2648	.05
2803	.07
2824A	1.10
2852	.05
2301	.62
2649	.05
2948	.12
3067	.12
6992A	10.40
6993	5.28
6995	1.15
7155	3.88
7741	1.47
7771	6.50

APPLICATION NOTES

80 W. Mono Conversion of SA 30-30 (SB Series only) or D-40

A. Wire Changes

1. Remove the bottom cover.
2. Remove mounting screws from mounting bracket of channel 2 circuit board. Do not remove mounting bracket from circuit board. (fig. 1)
3. Tilt circuit board up so under side is exposed. Cut trace shown in figure 2 with a knife.
4. Remove input wire from circuit board (fig. 2). Cut the other end from input level control. The level control for channel 2 will not be used in the SA 30-30.
5. Install two (2) jumper wires as shown in figure 1.
6. Install 20K vertical control (crown part number 1712) as shown in figure 1.
7. Connect 14 inch brown No. 22 copper wire to circuit board next to 20K vertical control. (figure 2)
8. Remount circuit board. Caution: Do not pinch any wires under the screws or mounting hardware.
9. Connect the second end of the 14 inch brown No. 22 copper wire to the output of channel 1. (figure 3)

B. Test

1. Adjust 20K vertical control to mid range before starting test.
2. Connect input signal of 1000 Hz at ½ volt to channel 1.
3. Connect AC VTVM to output of channel 1.
4. Adjust channel 1 level control until an output signal of 1 volt is obtained.
5. Move AC VTVM to output of channel 2.
6. Adjust 20K vertical control until an output level of 1 volt is obtained. The meter must read exactly as it did for channel 1.
7. Disconnect power from the SA 30-30 and reinstall the bottom cover.

C. Operation

1. Make output cable as shown in figure 4.

Note: Grounds are not used.

Caution: Do not connect either output to ground. Output signal is balanced and not to ground.

2. Connect one plug of output cable to channel 1 and the other plug to output of channel 2.
3. Connect speaker system to output cable. Minimum load impedance is 8 ohms.
4. Connect signal source to channel 1 input.

D. Specifications

Power Response:	60 watts into 16 ohm load. ±1 db 15 Hz to 40 KHz continuous. 80 watts into 25 volt line ±1 db 20 Hz to 20 KHz.
Frequency Response:	±0.5 db from 15 Hz to 70 KHz. (1 watt into 16 ohms)
Damping Factor:	Greater than 150 from 10 Hz to 1 KHz. (60 watts into 16 ohms)
Recommended Load:	16 ohms (8 ohms may be used). Safe on all loads (including short circuits) and with all inputs. Foolproof protection system provided by limited-energy fused power supplies.
Distortion (IM):	Less than 0.50% from 0.01 watt to 60 watt. Typically 0.2% (60 Hz and 7 KHz 4:1 16 ohm load).
Hum and Noise:	Greater than 95 db below 60 watts into 16 ohms. (20-20 KHz input shorted)
Input Signal:	Maximum of 0.85 volt (level control CW) for 60 watts into 16 ohms.
Input Impedance:	Minimum 20K unbalanced.
Power Requirements:	120 VAC; 110 watt for 60 watt output into 16 ohms. Less than 10 watts at idle.

Other specifications essentially the same as the 30-30.

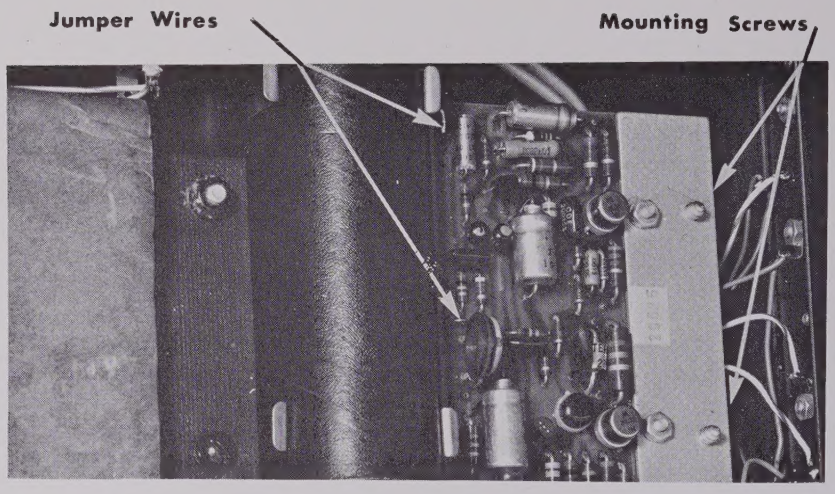


Fig 1

CHANNEL 2

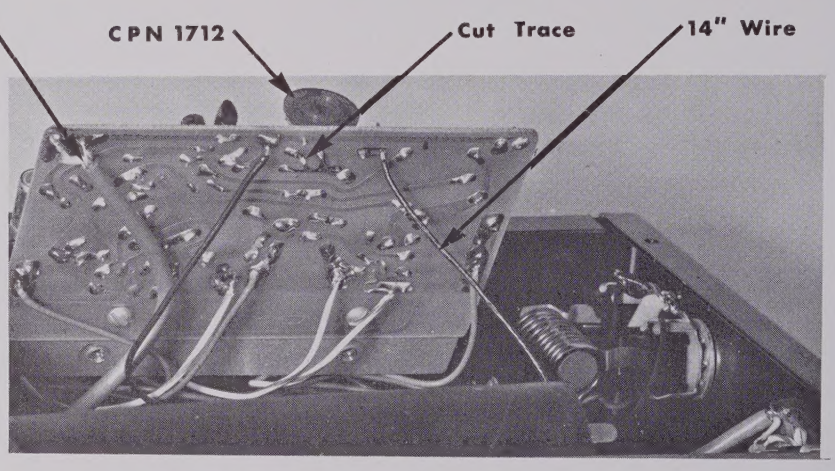


Fig 2

CHANNEL 2

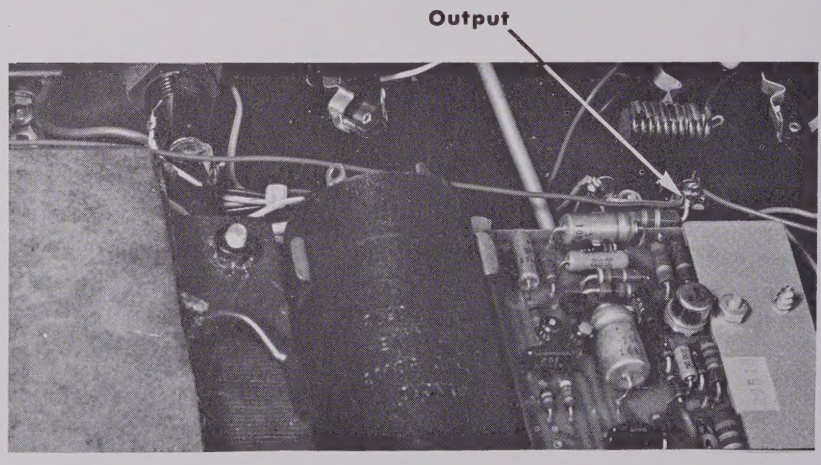


Fig 3

CHANNEL 1

NOTE: SB Series shown -- on SC Series, use *center* terminal as output.

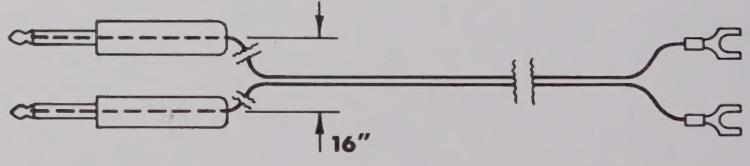


Fig 4